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trade in musical boxes, but a visit to the establishment of M. J. Paillard will convince the most sceptical that automatic musical in-

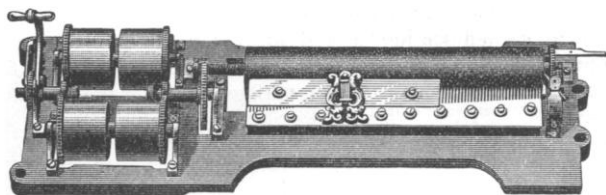


FIG. 6.

struments play an important part in satisfying the musical demands of the public.

MENTAL SCIENCE.

The Illusions of Drawing and Painting.¹

THE arts of drawing and painting depend upon the possibility of presenting to the eye a result in two dimensions of space which it will readily transform into one of three dimensions. In this process there is a large element of illusion — of conscious, designed illusion. The chief factor in this process is perspective. If the spectator take, whether in imagination or reality, the position of the artist when making the design, the image on his retina will be the same as that on the artist's retina, and the design will be recognized as the counterpart of the reality, provided the spectator knows in general the nature of the object represented. If the facsimile is to be more exact, color must be imitated, light and shade introduced, and the retinal effect copied with all the skill of eye and hand. In order to have an æsthetic effect, the picture must represent known objects: the interpretation of two-dimensional objects into three-dimensional must be rendered easy by the knowledge of the three-dimensional. The artist must not create entirely new forms: exceptions are apparent only, and prove the rule. The poetic monsters are either conventionalized, or unite incongruous but existing forms, — half man and half beast. This is especially necessary when the object of the drawing is purely intellectual, — to make clear something not easily expressed in words, such as designs for houses, mechanical constructions, and the like. Here a more or less exact knowledge of the type of object represented is needed. To the layman such designs have little meaning.

In artistic painting, however, it is not the most detailed and exact drawing that produces the best result. Photography excels all manual art in this, but its effect is of a lower order. The same can be said of those clever productions by which a bas-relief appears drawn in two dimensions, or the objects of a panorama to stand out in three. One admires the skill, but it is a curiosity rather than a piece of art. But the object of art is not servile imitation, not to give the spectator an absolute illusion, but to arouse certain feelings, certain thoughts; and those details must be chosen that bring to mind the appropriate sentiments.

The spectator of a painting never loses entirely the sense of viewing a painted surface: for (1) the drawing is strictly accurate only for one point of view; every change of position vitiates the perspective; (2) the phenomena of binocular vision prevent the illusion (the points of the canvas are seen at the real distance of the eye from the canvas, and not at the various distances required by the perspective; while, furthermore, the real object would form different images on the two retinæ, and the painting gives two nearly alike); (3) even in viewing objects monocularly, we get impressions of distance, for the eye constantly moves, while these changes are quite different in viewing a painting with one eye (the illusion of a painting is no doubt increased by regarding it monocularly through a hollow tube); (4) color and light can be imitated, but their mental effect is recognizably different from that of the real objects.

A picture placed in a horizontal position produces the illusion nearly as well as in a vertical position. If it be a marine view, the water does not seem vertical in the former case, though in the latter it seems horizontal. If it be an architectural design, it is not displaced, any more than we confuse directions when we gaze at

an object in a reclining position. This is the result of much practice in seeing the form of representations irrespective of their position, and in transforming the actual retinal image into the one that the artist intends. If you dispense with all light and shade, with all color, with all perspective, and leave simply a bare outline, then we can see in such an outline all the various designs which it can physically represent. If you draw one square within another and join the corners, you can see such a figure either as the description just given, or as the picture of a shallow trough looking into the bottom, or as a view of the same object from the bottom; and so on. Light and shade, familiarity with the design, decide what we shall see. This does not mean that the artist may neglect perspective, but only that the object of the perspective is to make easy the mental apprehension of the spectator. Cases occur in which a painter violates the rules of perspective, if by following them he would produce a scientifically accurate but apparently unnatural result.

In the perception of distance the objects touching the lower edge of the canvas are, as a rule, meant to be seen as in the plane of the canvas. This gives the spectator his point of view, while the framing of the picture by supplying a vertical and a horizontal, aids very materially his conception of position. If in a landscape we have the ground touching the lower end of the canvas, and the sky the upper, we can judge distances best. If a prominent object is cut at the edge of the canvas, it increases the difficulty of distance perception. Of course, the size of the painted objects need bear no approximation to the actual size. Our eye is trained to perceive form relations independently of size; and, if the real size of the object is familiar, we involuntarily suppose a more distant point of view. So, again, we generally underestimate the size of colossal figures, because we allow too much for our distance from them.

A more complete proof that imitation is not the artist's chief aim is that he attempts to represent motion in a single view, which physically is impossible. When a tree is represented in a wind, its branches are shown bent and strained in the direction of the wind; and this gives us at once the picture of a wind, of motion. So in a figure the attitude characteristic of a series of motions stands for the motion itself. It is not so much the fidelity as the suggestiveness of the attitude that is important. So, again, when objects move very rapidly, they become indistinct to our vision, and by painting them as indistinct the illusion of rapid motion is aided. If the motion is too rapid for the eye to follow, as in the rotation of the spokes of a carriage-wheel, the peculiar appearance can be imitated on canvas, and suggests extreme speed.

In the walk or run of an animal, although one position follows another with great rapidity, the eye selects certain positions as typical, and these the artist uses as the presentation of movement. Generally the position at the beginning or the end of a step is chosen. Instantaneous photography shows the great variety of positions in passing from one step to another; but many of these have an unnatural appearance to the eye, and the artist cannot utilize them.

A very distinctive illusion is shown in many portraits in which the eyes seem to follow the eyes of the spectator. This occurs when the model's eyes are facing the artist's. We assume the position of the artist, and so have the eyes in the picture looking at ours. If we move to one side, we get the illusion of the portrait's turning about, because the eyes still suggest direct vision, and the rest of the pose does not strongly contradict it. This lateral displacement, brought about by a change of position, is very slight in a painting, while very marked in a three-dimensional object. Paintings of animals frequently show similar effects. The true artist must understand and utilize such illusions, for they make the difference between what is lifelike and what is artificial.

THE HOMING INSTINCT. — Dr. George M. Gould (*Progress*, October, 1888) has collected authentic cases of animals finding their way homeward over long distances. Dogs, even when carried away in a blindfolded or drugged condition, find their way home over distances from five to five hundred miles; and in one case, when the dog was taken off along the two sides of a triangle, he came home by the third side. The exquisitely trained instinct of the flying pigeon, and similar capabilities of most animals, show the

¹ By M. J. L. Soret, in *Revue Scientifique*, Nov. 3, 1888.

great importance of this faculty. By way of explanation, Dr. Gould suggests, that, without the faculty of finding the way homeward, the sphere of an animal's life would be very narrow. The maintenance of the species would develop the power of seeking new fields and the power to turn homewards. The ordinary senses cannot account for this homing instinct, as actual experiments have shown. Dr. Gould sees here the true sixth sense, and regards it as a sensibility to changes in electric and magnetic tension, due to position on the earth's surface. The home is the animal's north pole. By habit, it is accustomed to the magnetic conditions there, but when away is restless, and finds its way homeward by this mysterious compass. Dr. Gould connects with this some fanciful speculations as to the import of the pineal gland as a possible magnetic organ, and some hints as to the physical nature of homesickness in mankind.

ELECTRICAL NEWS.

A Novel Telephone.

WE take the following from a recent issue of the *New York Electrical Review*: "The Lowth stettio-telephone hails from Chicago, and is a combined transmitter and receiver. A hollow extension about four inches long is attached to the receiver, from the end of which a small button protrudes slightly. The button is placed against the throat near the vocal chords, and the receiver is held against the ear in the usual manner. When the operator speaks, the vibrations of the throat are transmitted with, it is said, distinct clearness. The instrument is operated by the muscular vibrations that accompany the utterance of words. The inventor, James Lowth, is said to have been experimenting and working on this instrument for over ten years. When he first applied for a patent, three years ago, the authorities at Washington thought him a crank, and refused to issue one. He attached the instrument to wires in the office, and asked over it, 'What do you think now?' Back over the wire came, 'I give in. It works perfectly.' Our Chicago informant says it has been successfully operated between that city and Milwaukee, and in Pittsburgh it worked over a line seventy-five miles in length, on which were twenty-five Bell instruments." While, if the evidence is correct, this instrument certainly works, yet it is difficult to see how sounds produced by changing the relative positions of the tongue, teeth, and lips, such as go to make up a large part of the human voice, are accurately transmitted by this telephone. Never having seen one of these instruments, we do not yet "give in."

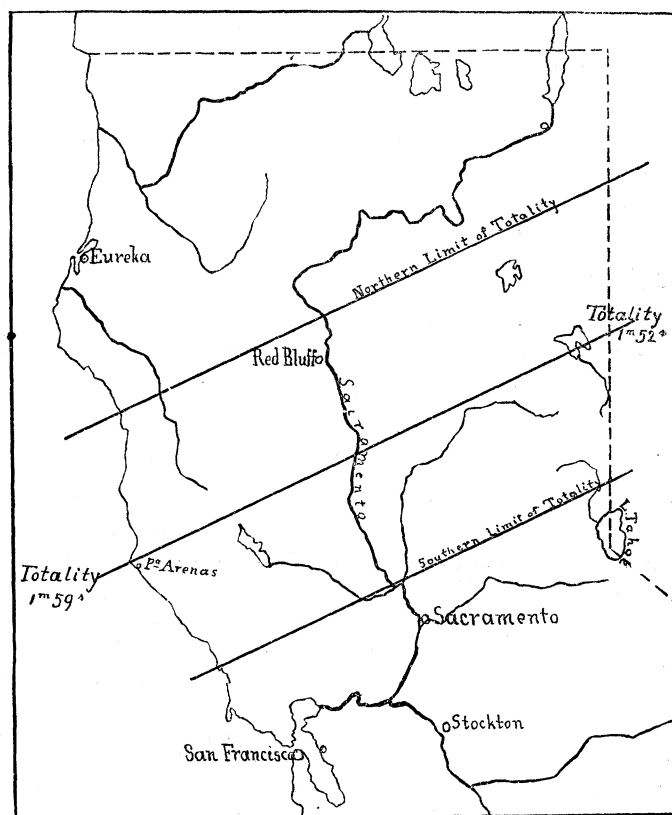
FAURE'S NEW SECONDARY BATTERY.—In this battery M. Faure uses finely divided metals pressed together in a self-supporting mass, or metal plates are used having combined with them finely divided particles of the same metal. Each plate is surrounded by a sheet of prepared asbestos, the sheet being a thirty-second of an inch thick, dipped first into some soluble salt, and then into a solution of a soluble silicate capable of producing with the first an insoluble compound. In his cell M. Faure uses zinc combined with finely divided zinc, and copper combined with finely divided copper. The solution used is phosphate of potash. On subjecting such a cell to the action of the electric current, phosphate of copper is formed on the surface of the copper element. M. Faure then substitutes a fresh solution of phosphate of potash, and, upon discharging the battery, phosphoric acid is transferred from the solution to the zinc, and from the copper to the solution; so that the solution remains unchanged as regards its constituent elements. The preliminary preparation would be avoided if phosphate of copper were placed upon the copper element in the first instance; but phosphate of copper is not easy to obtain and manipulate, and the process described is said to accomplish the desired object.

AN ITALIAN COMMISSION ON ELECTRIC TRACTION.—The Società Anonima degli Omnibus of Milan some time ago selected three engineers to travel through Europe, inspect the various electric-traction roads in operation, and report on the adaptability to the tramways in Milan. The main part of the report of the experts is taken up with the description and discussion of storage-battery systems; overhead, underground, and rail conductor systems being only incidentally mentioned. The commission was unable to make

a report on any line that was a complete financial success. The system in Brussels has not given perfect satisfaction, although improvements have been made that will reduce the cost. The road is on a small scale, however, and it does not necessarily follow that it would not pay, even now, if it was on a larger scale. The road, too, is a difficult one, with long grades of over three per cent. A careful study was made of the different types of accumulators in use at present, and an estimate is made of the comparative cost of storage-battery traction, as compared with that of horses. As a result, the commission advised that electric cars be tried, and states that it would be an honor to Milan, which was one of the first cities in the world to adopt electric-lighting on a large scale, to be also one of the first to utilize electricity for the propulsion of its tramcars.

NOTES AND NEWS.

MR. H. P. TUTTLE has recently indicated on a map of California the shadow path of the total eclipse of the sun which occurs on Jan. 1, 1889, and through his kindness we are enabled to reproduce this map. The cone of darkness will first appear on the western



coast of California, the central line passing near Punta Arenas. The space within the lines marked 'northern limit' and 'southern limit' indicates that in which the eclipse will be total. The duration of the eclipse will be about two minutes.

—During the past week the Society of Amateur Photographers of New York has been holding at its rooms, 122 West 36th Street, an informal exhibition of prints, the work of members of the society. The exhibition has proved very successful; so much so, that, at the request of many visitors, the exhibition will continue until Saturday, Dec. 15. About six hundred pictures are exhibited, and include views in many parts of Europe, China, Japan, Corea, the United States, historical buildings in this city, flash-light pictures, etc. The rooms will be open from 10 A.M. to 6 P.M., and from 7 to 10 P.M. every day and evening this week, except Tuesday evening. There is no charge for admission, and non-members of the society wishing to see the exhibition can obtain tickets by writing to the secretary of the society.